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ABSTRACT

The study examined parental influence on the math self-concept of 165 high-achieving adolescent girls. The research assessed the impact of parent attitudes about their own math abilities, parent expectations for their daughters, and degree of parent-child identification on the girls' own math self-concepts. A series of path analyses revealed that parent expectations have a significant impact on adolescent girls' beliefs about their own mathematical ability, regardless of parent-child identification. Parent math self-concept has little direct effect on daughter math self-concept, although it has a modest effect on parent expectations for daughters. Includes 17 references. (Author/JDD)

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AEL Minigrant Report No. 20: PARENTAL INFLUENCES ON THE MATHEMATICS SELF-CONCEPT OF HIGH-ACHIEVING ADOLESCENT GIRLS

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ABSTRACT

Previous studies have documented that girls with proven mathematical ability often have poor self-concepts regarding their ability to do math. Adolescent girls who do well in math tend to attribute their performance to effort instead of ability (Parsons, Adler, & Kaczala, 1982). Research also indicates that their parents share that belief. Furthermore, studies show that these parents have lower expectations for daughters than sons when it pertains to mathematics performance (Parsons, Adler, & Kaczala, 1982). Thus, the hypothesis has evolved that parent attitudes may adversely affect their daughters' conceptions of their mathematics ability, although the mechanism of this influence is not clear.

The current study examined parental influence on the math self-concept of 165 high-achieving adolescent girls and their parents. This research assessed the impact of parent attitudes about their own math abilities, parent expectations for their daughters, and degree of parent-child identification on the girls' own math self-concepts.

A series of path analyses revealed that parent expectations have a significant impact on adolescent girls' beliefs about their own mathematical ability, regardless of parent-child identification. Parent math self-concept has little direct effect on daughter math self-concept, although it has a modest effect on parent expectations for daughters. These results suggest that teachers, school psychologists, and guidance counselors need to involve parents in efforts to help adolescent girls improve their attitudes toward math.

INTRODUCTION

Many adolescent girls with high academic ability express poor attitudes toward the study of mathematics (Sherman, 1980). Girls and boys demonstrate equal ability in mathematical problem solving and mathematical concepts in the eighth grade. However, by the eleventh grade, boys perform significantly better than girls on standardized tests, and girls are significantly less confident in their mathematical abilities (Sherman, 1980). This lack of confidence may lead to taking fewer math courses. In fact, even young women with demonstrated mathematical aptitudes often shun high school courses in mathematics, in effect, choosing to forgo full development of their abilities (Malcolm, 1988).

The decision not to take math courses is significant in terms of one's career, because mathematics is crucial to the study of many scientific, technical, and even social science fields, such as economics. The acute shortage of women in science and technology is widely recognized (Eccles, 1985).

The failure of young women to study mathematics may be a reflection of poor self-concepts regarding their abilities in the subject. Math self-concept has been established as a separate, measurable construct that can be distinguished from general self-concept, as well as academic achievement (Byrne, 1984). "Self-concept of ability" has been defined as "the assessment of one's competency to perform specific tasks or to carry out role-appropriate behaviors" (Eccles, 1983, p. 82).

Mathematics self-concept becomes especially noticeable when adolescent girls who do well in math attribute their performance to effort

instead of ability (Parsons et al., 1982). The poor self-concept of mathematics ability in females may be a product of parental influences. Parsons et al. (1982) found that parents believed their daughters, as opposed to sons, had to try harder in math. This held true even though girls and boys scored equally well, and the girls' general school performance surpassed that of boys. In addition, expectations that parents have for their children's performance in mathematics have been shown to have an impact on achievement (Parsons et al., 1982; Phillips, 1987). Further, the parents' attitudes about their own mathematics abilities may be communicated to their offspring, thus influencing the children's mathematics self-concept through a type of modeling process.

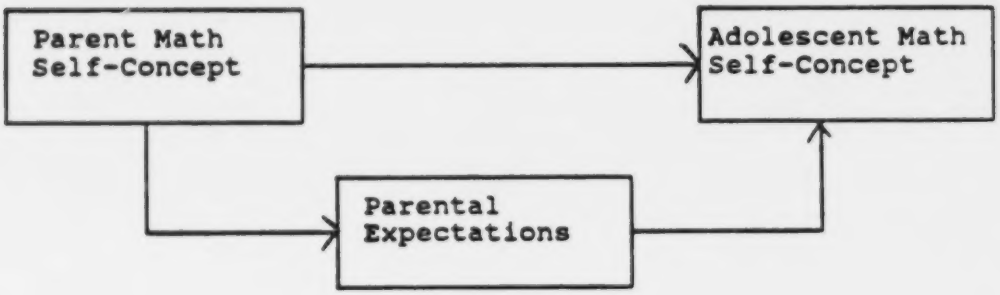
THE PRESENT STUDY

The present study attempted to investigate possible reasons for the low mathematics self-concept in adolescent girls. More specifically, this research examined the impact of parental attitudes and parent-child identification on girls' mathematics self-concept. It was proposed that a high degree of parent-adolescent identification would result in a positive correlation between parental mathematics self-concept and adolescent mathematics self-concept. It was hypothesized that if parents felt good about their own math ability and perceived a strong identification between themselves and the adolescent, the adolescent would have a similarly positive math self-concept. It was further proposed that in such highly identified subjects, parent mathematics self-concept would affect the expectations that the parents had for their children. These expectations were also predicted to affect the adolescent mathematics self-concept.

Under conditions of low parent-adolescent identification, parent expectations were expected to influence the adolescent's math self-concept, but parent math self-concept was not expected to have an impact.

The proposed path models for high and low parent-adolescent identification are outlined in Figure 1.

<u>High Parent-Adolescent Identification</u>



<u>Low Parent-Adolescent Identification</u>

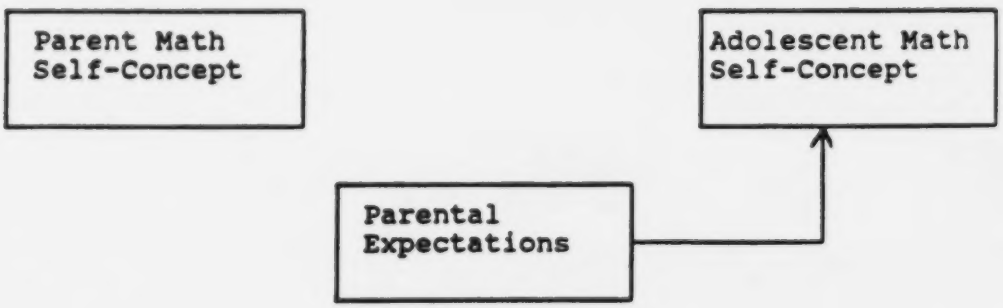


Figure 1

Proposed Path Model

THE ADOLESCENT GIRLS AND THEIR PARENTS

Data were collected from adolescent girls and their parents through the Summer Enrichment Program at the University of Virginia. This program is a two-week residential, educational program designed for high-achieving students from grades five through 11.

The sample consisted of 165 mothers, fathers, and daughters. To be eligible to participate in the study, girls had to be rising seventh through eleventh graders. Most of their families lived in various locations throughout Virginia, with six families coming from other states.

The mothers' average age was 41 years, the fathers' was 43 years. Mean age of the adolescent girls was 13, and ages ranged from 11 to 16 years. Grade level ranged from seven to 11, with a mean of 8.5. Approximately 90 percent of the subjects were white.

Approximately two-thirds of the mothers and three-fourths of the fathers had college degrees. Fifty-one percent of mothers and 70 percent of fathers were rated in the highest three occupational categories of the Hollingshead (1975) scale.

Achievement test scores were obtained for the adolescent girls in the areas of reading, language, math, and science. The mean national percentile ranking in reading, language, and math was 95th. In science, the mean national percentile ranking was 92nd.

MEASURES

A series of questionnaires was administered to parents and their adolescent daughters in order to measure mathematics self-concept, degree of parent-child identification, and parental expectations for their daughters.

Adolescents

Adolescent math self-concept was assessed with the Mathematics Attitude Scales (Parsons, et al., 1982; Eccles, 1980), a 23-item self-report questionnaire.

Parent-child identification was assessed with Schachter's (1985, 1982) adaptation of the Osgood et al. (1957) semantic differential technique. This technique requires subjects to rate themselves and their parents on a series of bipolar adjectives (7-point scales). Identification scores between the adolescents and each parent were derived by subtracting the scores for the parent and adolescent on each item, taking the absolute value of each score, and then summing the scores into a total identification score. For more details regarding these measures, see Dickens (1989).

Parents

Parents were given a mathematics attitude scale (Parsons et al., 1982; Eccles, 1980) that measured math self-concept and expectations for their daughters. Parents also completed the bipolar rating scales (Schachter's 1985 and 1982 adaptation of Osgood, 1957) used to assess parent-child identification from three perspectives: daughter, mother, and father.

PROCEDURE

Parent data were collected by mail. The order of the questionnaires was systematically varied from subject to subject. Mothers and fathers were asked not to discuss the questionnaires with each other. The adolescent girls completed questionnaires during two group administrations

at the Summer Enrichment Program. The girls were asked to describe themselves and their parents during separate administrations to minimize the possibility of purposefully patterning descriptions of themselves after that of their parents.

DATA ANALYSES

Seven major analyses were conducted. Each of the first four analyses examined the proposed model according to whose perspective was used to determine the parent-adolescent identification:

- identification perceived by the adolescent,
- identification perceived by the mother,
- identification perceived by the father, and
- identification perceived by a combination of the adolescent, mother, and father.

The fifth analysis looked at the proposed model according to high and low identification with mother only, while the sixth analysis compared high and low identification with father only. Finally, the seventh analysis compared the high mother identification group with the high father identification group.

For each analysis, the following procedure was used:

(a) Subjects were divided according to "high" and "low" parent-adolescent identification. The high identification pairs consisted of adolescents and the parent with whom they most closely identified.

(b) For both the high and low identification pairs, the partial correlation was obtained between parent mathematics self-concept and adolescent mathematics self-concept. This analysis controlled for the parental expectations variable, in order to avoid possible influence that this variable might exert on adolescent mathematics self-concept.

(c) For both the high and low identification pairs, correlations were calculated between parent mathematics self-concept and parental expectations and between parental expectations and adolescent mathematics self-concept.

(d) In order to determine whether the high and low identification pairs differed significantly, either a single sample t-test or a z-test for independent samples was conducted.

(e) Path coefficients (Keith, 1988) were calculated in order to estimate direction and strength of causal relations hypothesized in the path analyses shown in Figure 1. Details of these analyses are reported elsewhere (Dickens, 1989).

STUDY FINDINGS

Parent Expectations and Adolescent Math Self-Concept

The correlation between parent expectations and adolescent math self-concept are consistently significant, regardless of who perceived the identification--the adolescent, mother, father, or a combination of these three. This relationship held true regardless of whether identification was high or low. All analyses between these variables resulted in positive and significant path coefficients, lending support for the hypothesis of a causal relationship between parent expectations and adolescent math self-concept in both the high and low identification dyads. This finding is congruent with previous research. Parsons, Adler, and Kaczala (1982) and Phillips (1987) found that parents' beliefs or expectations about their children's math abilities had a greater impact on their math self-concept than actual past performance. Phillips (1987) described parents as "interpreters" (p. 1318) of objective feedback (test scores). He noted that children use this feedback to form their own self-perceptions.

Findings about parent expectations in the present study point toward the possible roles that parents may play with their children regarding math self-concept. It appears that parents may serve as a gauge of what adolescents should expect of themselves. That is, through their expectations, they may relay how bright or talented they believe their adolescents to be, as well as how much effort they should put into doing well in math. Parents may also serve as limit-setters regarding math. Through their expectations, they may communicate upper and lower limits regarding their daughters' abilities.

The Role of Parent Math Self-Concept

Results suggest that parent math self-concept does not have a direct effect on adolescent math self-concept. Even though a few of the simple correlations were significant, although low, this significance disappeared when parent expectations were controlled in all but one analysis. (The exception is described later.) Further, none of the path coefficients between parent math self-concept and adolescent math self-concept were significant in either the high or low identification dyads. These findings support previous findings by Parsons, Adler, and Kaczala (1982). These findings indicated no significant relationship between parent and child math self-concept. Phillips (1987) also documented no relationship between parents' perceptions of their own abilities and children's beliefs about their abilities.

However, there is evidence that parent math self-concept has an indirect effect on adolescent math self-concept--an effect via parent expectations. In five of seven analyses, the path coefficients between parent math self-concept and parent expectations were significant. This

suggests a causal relationship between parent math self-concept and parent expectations. As noted earlier, there was consistent evidence for a causal relationship between parent expectations and adolescent math self-concept. Thus, parent math self-concept does appear to influence adolescent math self-concept indirectly through parent expectations. How parents feel about their own math ability appears to affect the expectations that parents have for children. This feeling, in turn, affects the adolescents' math self-concept. Specifically, the higher the parents' own math self-concept, the higher their expectations for the adolescent. Likewise, the higher the parents' expectations, the higher the math self-concept of the adolescent.

This indirect relationship between parent math self-concept and adolescent math self-concept suggests that, through a modified process, role modeling may occur. Expectations may be one way in which parents transmit beliefs about their own abilities to their adolescents. It may be that parents project beliefs about their own competence onto their adolescents through their expectations. In essence, how good parents believe they are in math may affect what these parents believe is possible for the adolescent, and this may in turn influence how high or low the parents' expectations are for the adolescents. Parents may hold similar values for their adolescents as they do for themselves. For example, if parents believe they are very capable at math, they may believe it is fair to expect their adolescents to also do well in the subject. Likewise, if parents hold a poor opinion of their abilities in math, they may not feel justified in expecting the adolescent to do better than they are capable of doing.

Differences Between High and Low Identification

It was hypothesized that identification would play a major role in adolescent math self-concept. As noted, it was thought that the adolescents' math self-concept would be more similar to that of the parent with whom they were more highly identified. However, the results did not provide support for this hypothesis.

Parent Gender Differences

Researchers found one occasion in which differences existed between mothers and fathers--the correlation between parent math self-concept and adolescent math self-concept when the highly identified mothers were compared to the highly identified fathers. Among highly identified mothers, support was evident for a significantly different relationship between these two variables, with the relationship being stronger for mothers than fathers.

It is possible that the hypothesized relationship between parent math self-concept and adolescent math self-concept occurs only under a combination of two circumstances: when the relationship is between mothers and daughters, and when there is very high (as opposed to moderately high) mother-daughter identification. When only the most highly identified mother-daughter pairs (the top 21) were studied, the relationship between these variables became significant. Thus, it appears that the highly identified mother-adolescent condition may be unique in being the only situation in which parent math self-concept is directly associated with adolescent math self-concept. In such high identification situations, role modeling may be more likely to occur.

DIRECTIONS FOR FUTURE RESEARCH

While the current study included several variables judged to be most important in influencing adolescent math self-concept, it is difficult to comprehensively rule out all other potential influences in a single study. Other possible influences on adolescent math self-concept include those reported by Eccles (1983): past performance in math, children's perceptions of their parents' goals, and the children's perceptions of parents' perceptions regarding task difficulty. However, Eccles (1983) also found that these variables accounted for only a small amount of variance, and the influence of parent expectations far surpassed all of these variables. Kimball (1989) suggested three variables that may undermine girls' confidence in math, including little math experience outside the classroom, difficulty with novel versus familiar situations, and a "rote approach" (Kimball, 1989, p. 209) to learning math. Another possible influential variable is overall self-concept. It may be that the better adolescent girls feel about themselves in general, the more confident they will feel about their ability to learn and do well in math.

Potential limitations regarding the ability to generalize from the results of the present study include application to a lower-achieving population, lower socioeconomic status subjects, and nonwhite groups.

Future research should focus on learning more about parental influences, as well as the potential impact of other variables on adolescent math self-concept. One step would be to examine parent gender differences in more detail. For example, the relationship between parent math self-concept and adolescent math self-concept in highly identified

mother-daughter pairs, as opposed to highly identified father-daughter pairs, should be further studied. If the influence of mother math self-concept on parent expectations is a gender-related occurrence specific to the mother-daughter relationship, it is important to find out more details regarding the circumstances under which this occurs.

Still another direction for future research is whether parent-adolescent similarity in math represents a particular type of identification that may or may not coincide with other parent-adolescent identification. That is, an adolescent may be more strongly identified overall with one parent but may have a specific identification in math with the other parent. It is possible that the role modeling may occur in certain areas with one parent and in different areas with the other parent.

IMPLICATIONS FOR GUIDANCE AND COUNSELING

The current research has several implications for guidance and counseling with academically competent adolescent girls. First, actual ability, as well as math self-concept, should be assessed; any discrepancy between the two should be noted. In situations where children's performance is below their abilities, the possibility of a low math self-concept should be considered.

Second, teachers, school psychologists, and guidance counselors need to involve parents in order to help academically competent girls improve their beliefs about their mathematical ability--and thereby their mathematics interest. Parent involvement should include a comprehensive plan that educates parents and gives them a role in helping their daughters improve their math self-concept.

Results of the current study suggest several steps in the process of working with parents. First, both mothers and fathers should be informed about the tremendous impact of their expectations on their daughters' beliefs about their own competence in math. School personnel should share information with parents, including the findings that parents' beliefs and expectations regarding their daughters' math ability can have a greater impact on math self-concept than actual past performance (Parsons, Adler, & Kaczala, 1982; Phillips, 1987). Then, parents need to become more aware of exactly what expectations they have for their daughters' performance in math, e.g., how well parents think they can do in math, the amount of effort needed for them to do well, the degree of difficulty that they have with math, and their beliefs about their performance in future math courses.

If these expectations are in fact low, the reasons for these expectations should be explored. While the current study only investigated how parent math self-concept might contribute to parent expectations, other factors can be considered. For example, if parents do not expect their daughters to do well in math because they are female, they should be informed that girls usually make better grades in math than boys. "Thus it may be possible to use information about girls' superior math grades to convince parents of their daughters' math potential which may in turn increase girls' self-perceived math ability, performance, and course-taking" (Kimball, 1989, p. 210). In addition, parents should be informed that there has been a significant decrease in cognitive gender differences in arithmetic and figural reasoning between 1960 and 1983 (Feingold, 1988). Parents should also be alert to the fact

that their expectations should not be based on how daughters perceive their ability to perform in math, since even academically competent children vary in their perceptions of how well they can perform.

In summary, if parents have low expectations for their daughters' performance, they should be encouraged to actually change those expectations. Parents should be encouraged to convey that they believe their daughters are bright and can do very well in the subject. The combination of factual information about the ability and performance of girls in math and awareness of their own expectations are vital in achieving this goal.

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